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VARIATIONS IN ICE CONDITIONS IN THE NORTHERN SEAS

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The USSR has the most powerful icebreaker fleet in the world and occupies first place in ice exploration from the air. However, success in navigating the northern seas depends not only on the technical equipment of ships and aircraft, but to a great extent is determined by the changing ice conditions of these seas.

In a majority of cases, a man is mistaken if, in determining a plan of action for the future, he assumes that tomorrow will be the same as today. From his experience of a number of years with heavy ice conditions in the Kara Sea, in 1837 Academician K. Ber called that sea "the ice cellar." In the years immediately following, there was little ice in the Kara Sea, and Ber had to change the definition to "the cellar in which at the end of the summer there remains no ice." Thirty-five years later A. Peterman made another mistake. In 1873, from an impression formed during years which were favorable with respect to ice conditions, he concluded that the Kara Sea was navigable for a period of 5 months. At present, with a powerful ice breaker fleet and excellent aerial reconnaissance, ships navigate the Kara Sea not more than 4 months, and as a rule 2 or 3 months. Therefore, Peterman was mistaken in his opinion.

What variations do the ice conditions in the northern seas undergo, and what rule can there be which would make it possible to predict conditions for navigation on these seas?

To answer this question, we examined the regions and seas for which there are numerical data on ice research, for example, the regions of Newfoundland, the Baltic Sea (in the Kronstadt area), Davis Strait, the Iceland region, the Bering Sea, the White Sea, the Kara Sea, the Laptev Sea, the East Siberian Sea, the Chukotsk Sea, and the Tatarskiy Straits (the region of Zhonkiyer lighthouse).

Results of the investigation permit us to assert that each of the regions which we examined shows variations in ice conditions, indigenous only to the given region.

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While investigating the variations in ice conditions in t ese regions, we did not discover a constant reduction or increase in ice conditions in the series of years studied. The years with heavy or light conditions occur periodically. Such periods vary in length for each region.

Newfoundland region -- 24 - 25 years.

Iceland -- 94 - 100 years, with lesser intervals of 9 - 10, and 4 - 5 years.

Kara Sea -- 100 years, 9 - 10 years, and 3 3 years.

Chukotsk Sea -- 9 - 10 and 4 - 5 years.

For the seas of the northern sea route, in which we include the Kara, the Laptev, the East Siberian, and the Chukotsk Seas, a 10-year recurrence period for heavy ice conditions is characteristic. For example, in these seas heavy ice conditions were observed in the years 1926, 1936, and 1946. In the Baltic Sea and the Tatarskiy Straits, heavy ice conditions occur every 24 - 25 years.

The variations, indigenous to the separate regions, do not coincide with the variations common to all the northern seas or groups of seas. For example, variation phases in ice conditions in the regions of Iceland, the Barents, and the Kara Seas do not coincide with the variations in the Newfoundland region and the Davis Strait. Opposite trends are also noted in other regions.

a. Light ice conditions in the Kara and the Laptev Seas coincide with heavy conditions in the East Siberian and Chukots. Seas.

b. Light ice conditions in the Baltic Sea coincide with heavy conditions in the Tatarskiy Straits.

Examining the variations in ice conditions in the northern seas, we observed a distinct division according to areas of oceanic influence and, most prominently, according to atmospheric circulation over the Atlantic and Pacific Oceans.

With simultaneous accumulation of heat (that is, during the rise in intensity of atmospheric circulation) in the northern parts of the Atlantic and Pacific Oceans, ice conditions are reduced in a group of seas from the Baltic to the Laptev inclusive. On the other hand, they are intensified in a group of seas from the East Siberian Sea to the Tatarskiy Straits. Conversely, the lowering of heat reserves in the northern parts of the oceans affects the intensification of ice conditions in the group from the Baltic to the Laptev and the reduction of ice conditions in the group from the East Siberian Sea to the Tatarskiy Straits.

Accordingly, the system of variations appears as follows:

1. With the reduction of ice conditions in the seas from the Baltic to the Laptev, ice conditions increase in Davis Strait and in the Newfoundland region.

2. At the same time, ice conditions in the seas from the East Siberian Sea to the Tatarskiy Straits increase, while along the coast of Alaska to the Beaufort Sea they are reduced.

The first group of seas we treat are in areas influenced by the atmospheric circulation over the Atlantic Ocean; and the second, in areas influenced by the atmospheric circulation over the Pacific Ocean. In the appended diagram, the areas with simultaneous reduction of ice conditions are marked with a minus [illegible]. the areas with an increase are marked with a plus sign. The position indicated for areas with heavy and light ice conditions corresponds to increased accumulation of heat in the regions of the North Atlantic and the northern part of the Pacific adjoining the Arctic basin; therefore, to the increased flow of air masses in directions indicated in the illustration by continuous heavy lines. With decreased flow of air masses in the directions indicated the signs for the areas with heavy and light ice

conditions are reversed. Therefore, ships passing through the northern seas from the Atlantic Ocean to the Pacific or in the opposite direction, encounter the same quantity of ice.

Furthermore, an investigation of seasonal variations in ice conditions in the northern seas discloses corresponding minima and maxima in the conditions for different geographical regions. The maxima and minima in the Newfoundland area, Iceland, and in the northern sea lane are found to occur at the same time -- maximum in May, minimum in September - October. How can one explain the coincidence of maximum and minimum ice conditions in different regions of the polar basin?

The answer to that question lies in the results of calculations on the drift rate of ice in the region of the strait between Spitzbergen and Greenland, the work of the drift station "North Pole" and the expedition on the icebreaker Sedov. On the basis of these calculations, and taking into account the gradients of atmospheric pressure for Spitzbergen and Greenland, the annual pattern of variations in the rate of ice drift and the annual mean ice drift in the strait were calculated. (The gradient is a change of any quantity per unit of length. A pressure gradient is a change in the atmospheric pressure on the surface of earth, relative to degree of latitude.)

From the calculations, it was found that a shift of the ice in the Arctic basin occurs, on an average, over 4 to 5-year periods. This may serve as an explanation for the variations in ice conditions in the Greenland Sea and the Chukotsk Sea in periods of 4 to 5 years.

A study of the results of wind observations on Dickson Island shows that the winter type of monsoonal circulation (that is, winds blowing off the coast into the polar basin) depends on the sudden increase in the outflow of ice from the polar basin through the strait referred to above, in September and October, and contributes to the recession of the ice toward the north in the border seas of the Arctic basin. Aerial survey of the ice in autumn disclosed that the old ice which fills the seas in the navigation period recedes to the north, and often is completely absent at that time in the seas of the northern sea route.

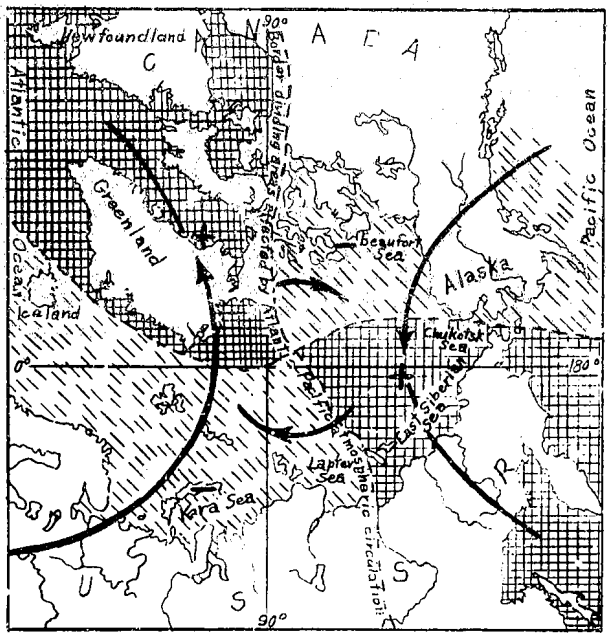

Diagram of Areas With (Simultaneous) Light (-) and Heavy (+) Ice Conditions in the Northern Seas

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